Calf Notes.com

Calf Note #255 – Antibiotic resistance in newborn calves

Introduction

The resistance of bacteria to antibiotics is a major problem in human and animal health. Human and animal medicine has experienced increasing incidence of multidrug resistance in clinical pathogens (Pichichero and Casey, 2007; Bolan et al., 2012). Antimicrobial resistance (**AMR**) is carried in the organisms' genetic material, which can be shared among different types of bacteria. The global dissemination of antimicrobial resistance genes, including emerging resistances to "last resort" antibiotics such as carbapenem and colistin, is a world-wide problem. In addition to pathogens, commensal bacteria are also reservoirs of AMR genes and influence AMR transmission.

Compared with human medicine, antibiotics are used more frequently for livestock. However, when pathogens affecting cattle become resistant, therapeutic options become more limited. Further, these resistant bacteria create reservoirs of resistance that can be transmitted to humans via the food chain or environmental effluents. None of this is good.

Escherichia coli (***E. coli***) are frequently found in intestinal tracts and feces of cattle and calves. Past about 48 hours of age, *E. coli* are thought not to cause infections, nor are they a major cause of disease in calves. However, they can transfer resistance genes to pathogenic *E. coli* strains or other Enterobacterales that can be transmitted to humans via the food chain or environmental effluents such as sewage (Marshall et al., 1990; Homeier-Bachmann et al., 2021).

The prevalence of AMR *E. coli* in dairy cattle is typically age-dependent with a higher prevalence and abundance in pre-weaned calves (Homeier-Bachmann et al., 2022). A recent study in Germany showed that 64% of the young calves in large dairies shed AMR resistant *E. coli* although most of them had never been treated with antibiotics (Weber et al., 2022). With advancing age and rumen development, calves become less of a reservoir for AMR resistant *E. coli*, as excretion in feces decreases (Liu et al., 2019; Springer et al., 2019).

Given the age dependent nature of the presence of AMR resistant bacteria in young calves, it's important to understand the source(s) of infection with AMR resistant bacteria. Of course, the use of waste milk from cows treated with antibiotics is a commonly identified as a vector for transmission of AMR resistant bacteria to young calves (Liu et al., 2019; Calf Notes 162 and 193). However, other sources may also exist.

In this Calf Note, we'll review research from Germany that evaluated calves for transmission of AMR via colostrum.

The Research

Holstein–Friesian calves (n = 15) were born on a dairy farm in Germany and were removed immediately from the dam. Calves were fed 3 L of previously pooled colostrum (all calves received the same colostrum). Thereafter, calves were transported to the University of Leipzig within their first 24 h of life and assigned to an experiment unrelated to measurement of AMR resistant bacteria (calves were part of a challenge study with *Cryptosporidium parvum*). Fecal samples were taken as part of this alternative study and tested for the presence of several types of bacteria. The researchers found that on the first day of life, 14 of 15 calves tested positive for AMR *E. coli*, although they had no contact with each other and did not get any antibiotics.

The barn, equipment, feeding utensils and transport vehicles were all disinfected prior to and during the trial; therefore, horizontal transmission between the calves and from the equipment, vehicles, or the barn seemed

unlikely. Moreover, the dam was ruled out as a source of the *E. coli*, as the prevalence of dams was low and the strains of *E coli* in feces of the cows differed from that of calves.

So, what was the source of contamination? The researchers suspected the pooled colostrum and/or the equipment used to collect, process, and feed the calves. The researchers collected a sample of the colostrum pool and swabbed equipment used to collect and feed the calves.

The Results

Pooled colostrum and swabs from the milking bucket tested positive for AMR resistant *E. coli*. The researchers conducted in-depth "fingerprinting" of the organisms to identify if the organisms in calf feces were genetically identical to those from colostrum and the milking bucket. In many cases, they were. Thus, the researchers concluded that the primary source of the contamination came from colostrum – the colostrum itself, of the equipment used to collect it.

The authors hypothesized that the primary source of contamination was the milking equipment. They based this assumption on the observation that the specific *E. coli* has are capable of forming biofilms, which protects the bacteria from typical cleaning procedures (Homeier-Bachmann et al., 2021). Other studies have reported that inadequate washing and disinfection procedures of milk feeding equipment (nipples, bottles, buckets) contribute to the contamination of calves with AMR *E. coli*. Heinemann et al. (2021) reported AMR *E. coli* in the inner surface of nipples of feeding buckets and concluded that sanitation measures in dairy farms were inadequate, thereby contributing to the spread of AMR *E. coli*.

Summary

The results of this study are important. Antimicrobial resistance of bacteria is a major problem to both veterinary and human medicine. Management on farms – particularly in the management of young calves – to reduce the risk of transmission of AMR *E. coli* is really important. As calf raisers and advisors to those raising calves, it's imperative that all steps are taken to clean and sanitize the feeds, and feeding equipment used to feed calves. Bachman et al. (2024) suggested the presence of biofilms on the milk bucket used to collect colostrum might have been responsible and pointed to other research that biofilms are common on milk feeding equipment on many dairy farms.

It's time to "step up our game" regarding sanitation of milk-fed calves to reduce the risk of further transmission of antimicrobial resistance genes among bacteria, including those important to human and veterinary medicine.

References

Bachmann, L., L. Weber, W. Liermann, H. M. Hammon, C. Delling, F. Dengler, K. Schaufler, M. Schwabe, E. Eger, K. Becker, A. Schütz, and T. Homeier-Bachmann. 2024. Colostrum as a source of ESBL-*Escherichia coli* in feces of newborn calves. Sci. Reports. 14:9929. https://doi.org/10.1038/s41598-024-60461-4.

Bolan, G. A., P. F. Sparling, and J. N. Wasserheit. 2012. The emerging threat of untreatable gonococcal infection. New Engl. J. Med. 366:485–487.

de Verdier, K., A. Nyman†, C. Greko and B. Bengtsson. 2012. Antimicrobial resistance and virulence factors in *Escherichia coli* from Swedish dairy calves. Acta Vet. Scand. 54:2. http://www.actavetscand.com/content/54/1/2.

Heinemann, C., C. D, Leubner, J. J. Hayer, and J. Steinhoff-Wagner. 2021. Hygiene management in newborn individually housed dairy calves focusing on housing and feeding practices. J. Anim. Sci. https://doi.org/10.1093/jas/skaa391.

Homeier-Bachmann, T. et al. 2021. Antibiotic-resistant Enterobacteriaceae in wastewater of abattoirs. Antibiotics (Basel). https://doi.org/10.3390/antibiotics10050568.

Homeier-Bachmann, T., J. F. Kleist, A. K. Schutz, and L. Bachmann. 2022. Distribution of ESBL/AmpC-*Escherichia coli* on a dairy farm. Antibiotics (Basel) https://doi.org/10.3390/antibiotics11070940.

Liu, J. et al. 2019. The fecal resistome of dairy cattle is associated with diet during nursing. Nat. Commun. 10:4406. https://doi.org/10.1038/s41467019-12111-x.

Marshall, B., D. Petrowski, and S. B. Levy. 1990. Inter- and intraspecies spread of *Escherichia* coli in a farm environment in the absence of antibiotic usage. Proc. Natl. Acad. Sci. USA 87, 6609–6613. https://doi.org/10.1073/pnas.87.17.6609.

Oh, S., S. Ha, J.-H. Roh, T.-Y. Hur and J. G. Yoo. 2020. Dynamic changes in antimicrobial resistance in fecal Escherichia coli from neonatal dairy calves: An individual follow-up study. Animals. 10:1776. https://doi.org/10.3390/ani10101776.

Pichichero, M. E. and J. R. Casey. 2007. Emergence of a multiresistant serotype 19A pneumococcal strain not included in the 7-valent conjugate vaccine as an otopathogen in children. JAMA-J. Am. Med. Assoc. 298:1772–1778.

Springer, H. R. et al. 2019. Antimicrobial resistance in fecal Escherichia coli and Salmonella enterica from dairy calves: A systematic review. Foodborne Pathog. Dis. 16, 23–34. https://doi.org/10.1089/fpd.2018.2529

Weber, L. P. et al. 2021. Prevalence and risk factors for ESBL/AmpC-E. coli in pre-weaned dairy calves on dairy farms in Germany. Microorganisms 9:2135.

Written by Dr. Jim Quigley (14 November 2024)

Calf Notes.com (https://www.calfnotes.com)